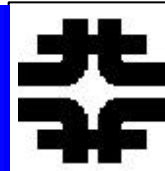




US CMS



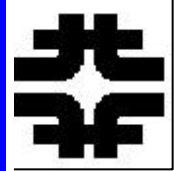
Dan Green

US CMS Construction PM

April 26, 2002



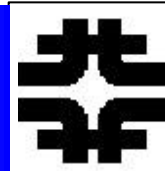
Outline



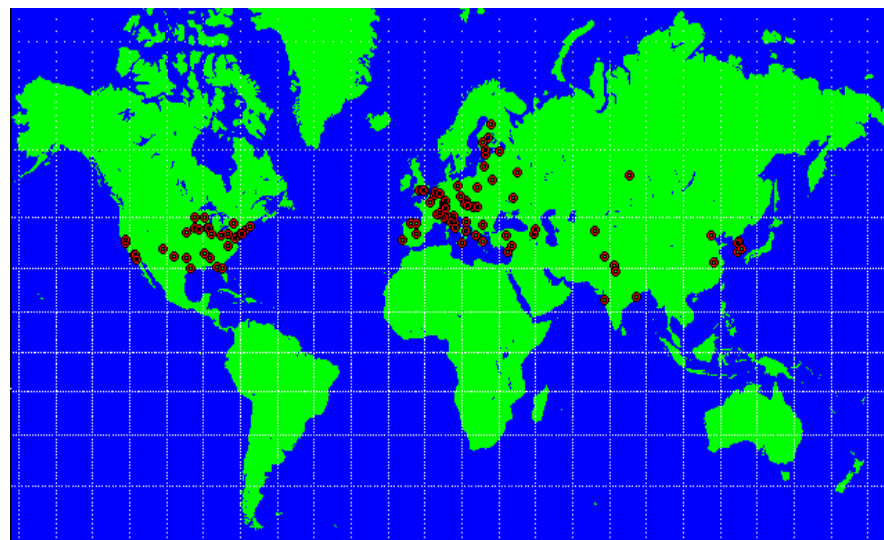
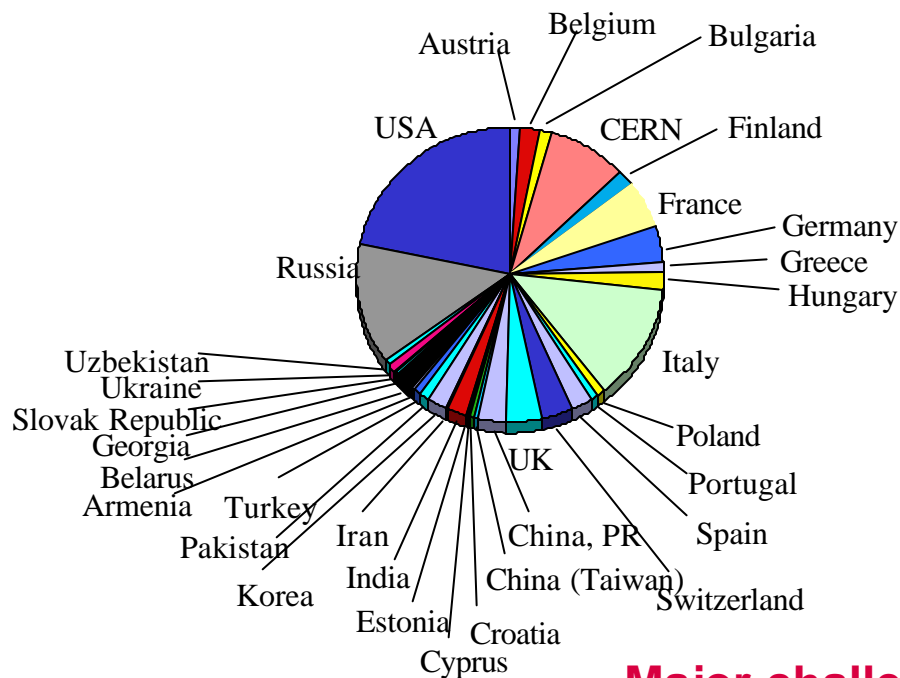
- Overview – CMS
- Detector Construction
- Project Office Activities – US CMS
- SWC
- The Research Program



CMS



1800 Physicists, 147 Institutes, 32 Countries



Major challenges due to geography

An example is LHC computing:

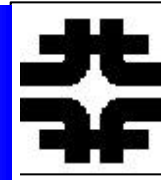
Communication and collaboration at a distance

Distributed computing resources

Remote software development and physics analysis



Higgs Discovery Limits



CMS is, however, united in the desire to do the Physics. To effectively exploit the physics potential of the LHC and the investment put into the machine and the detectors CMS needs to COMPLETE its detector, commission and then operate it.

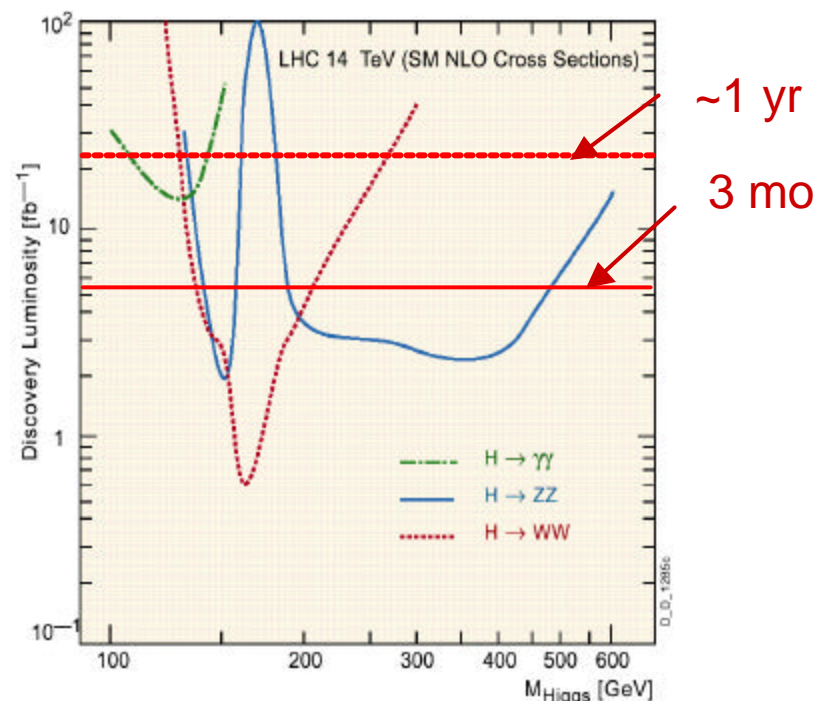
At $L_0=2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$:

1 fill (6hrs) $\sim 26 \text{ pb}^{-1}$

1 day $\sim 60 \text{ pb}^{-1}$

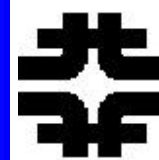
1 month $\sim 2 \text{ fb}^{-1}$

1 year $\sim 20 \text{ fb}^{-1}$

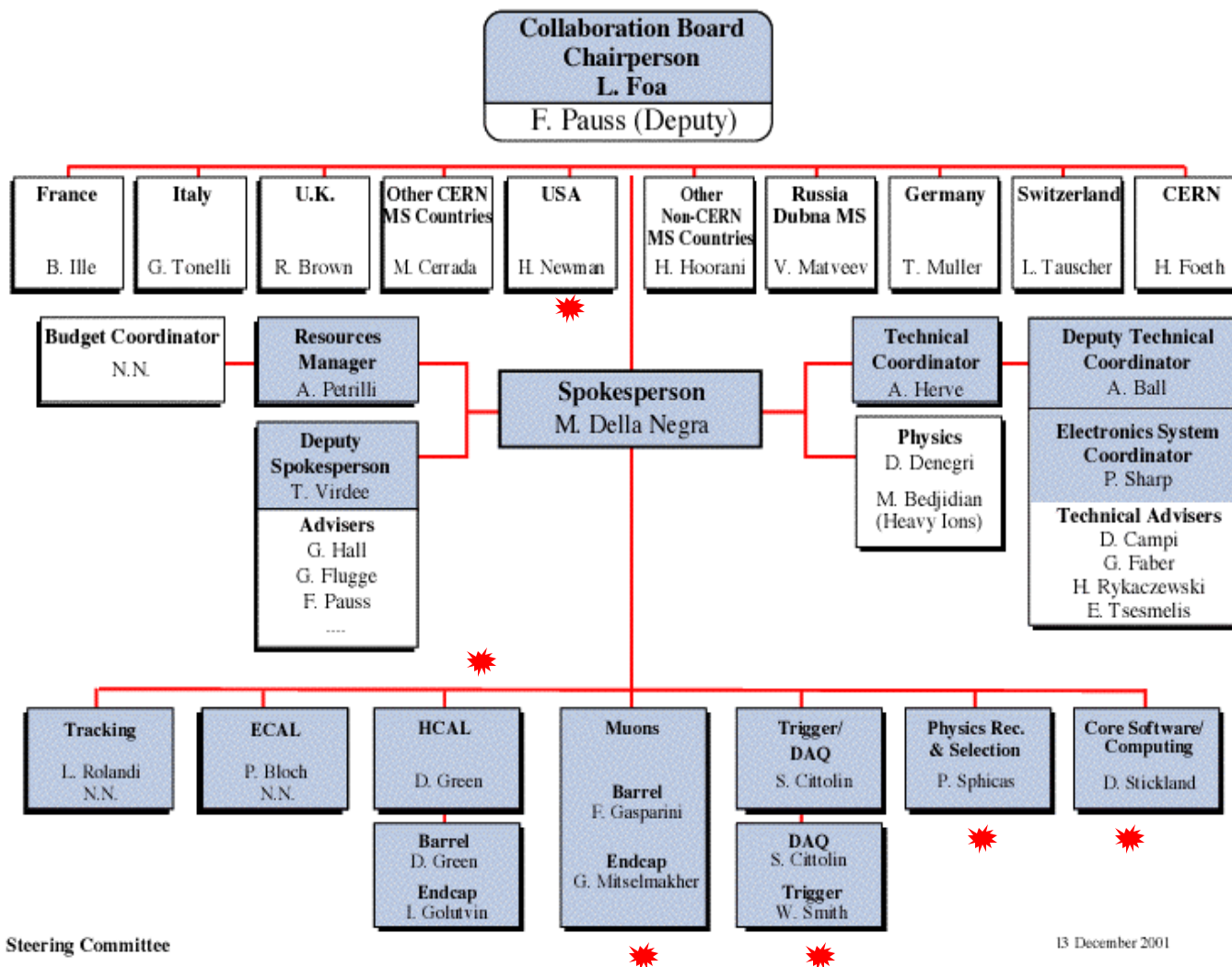




CMS Management

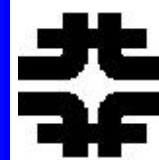


CMS Management Board and Steering Committee

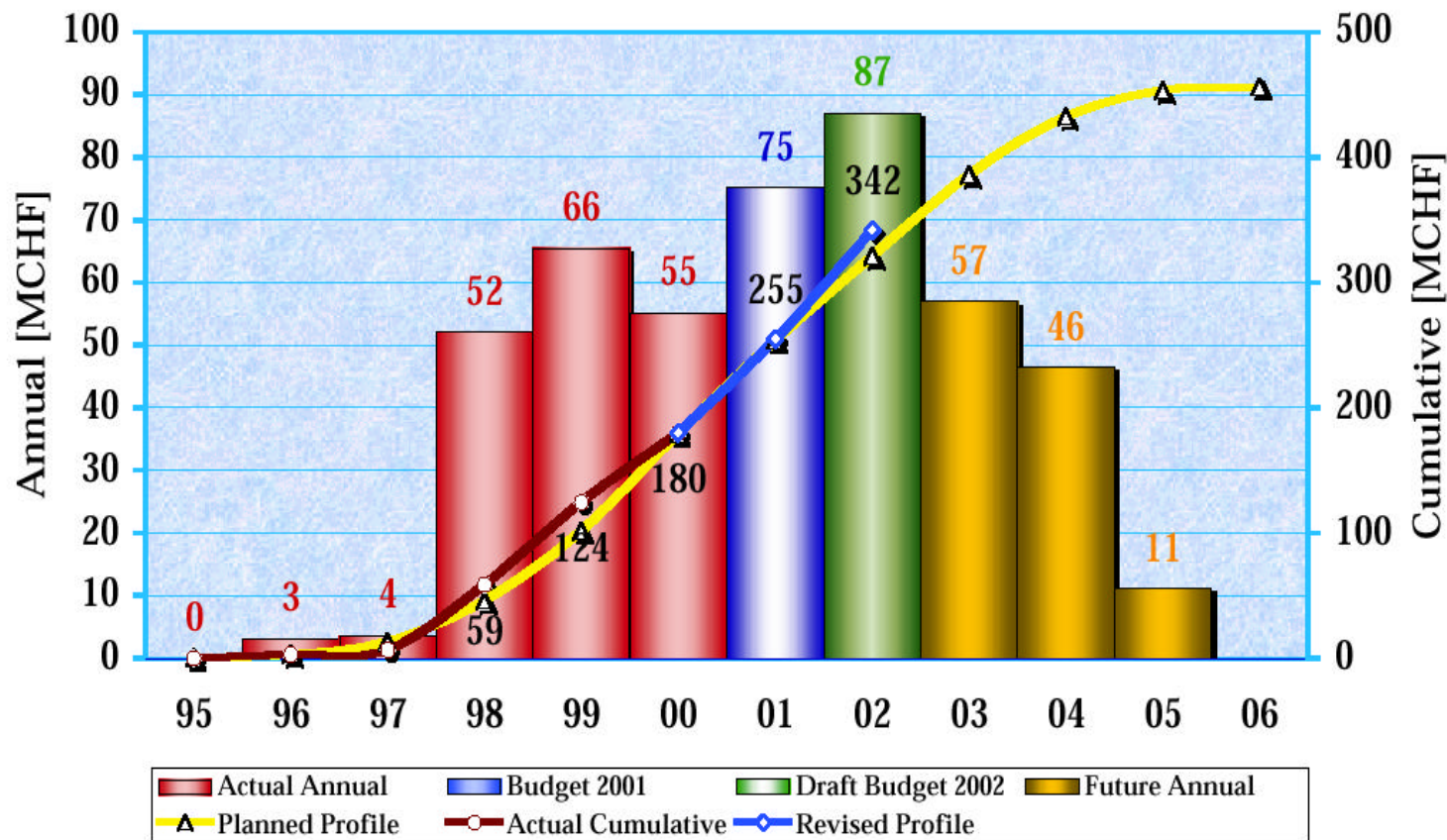




CMS Construction



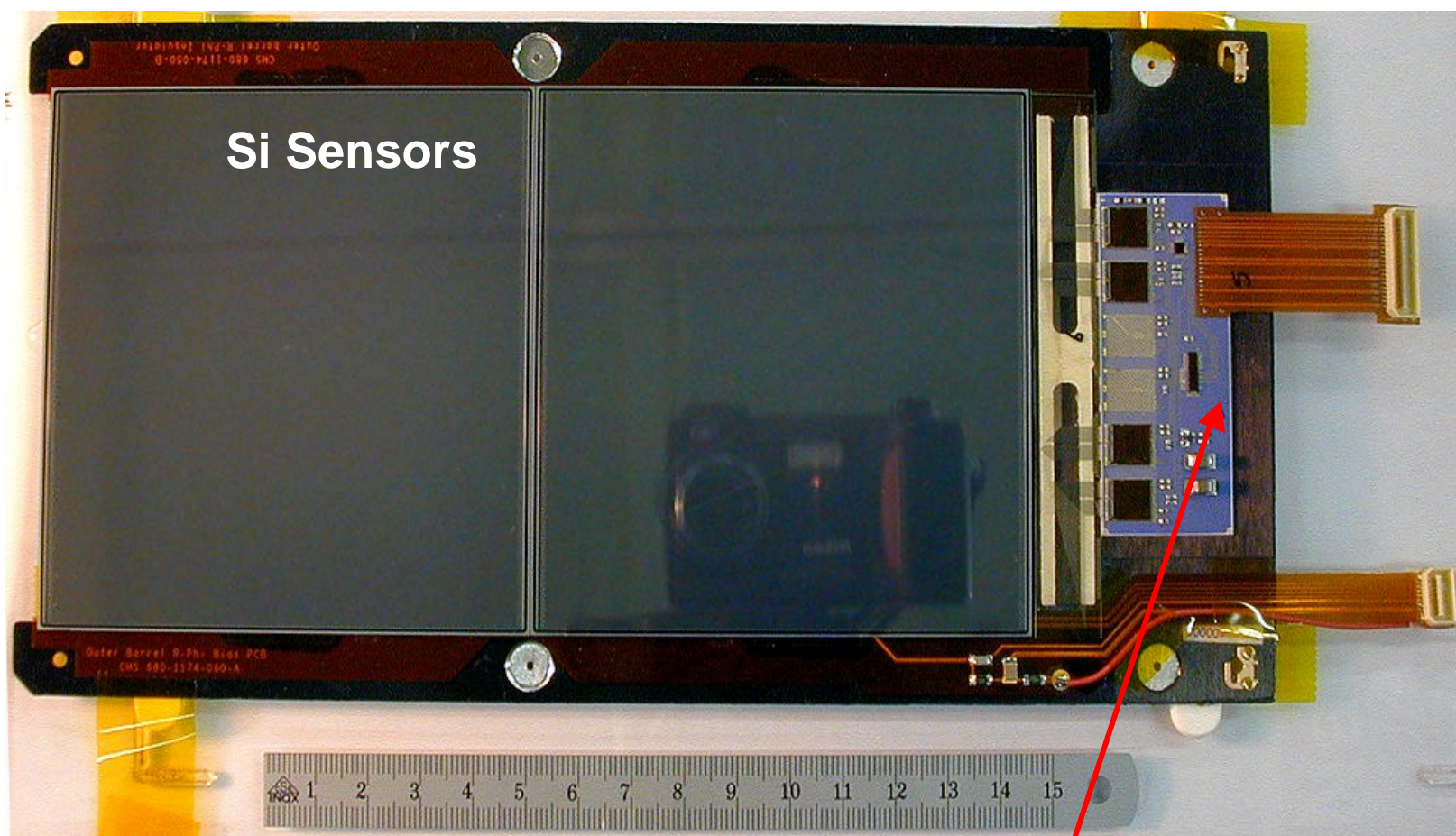
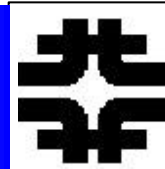
Commitments for CMS Construction



By end of next year ~70% of the detector will have been committed.



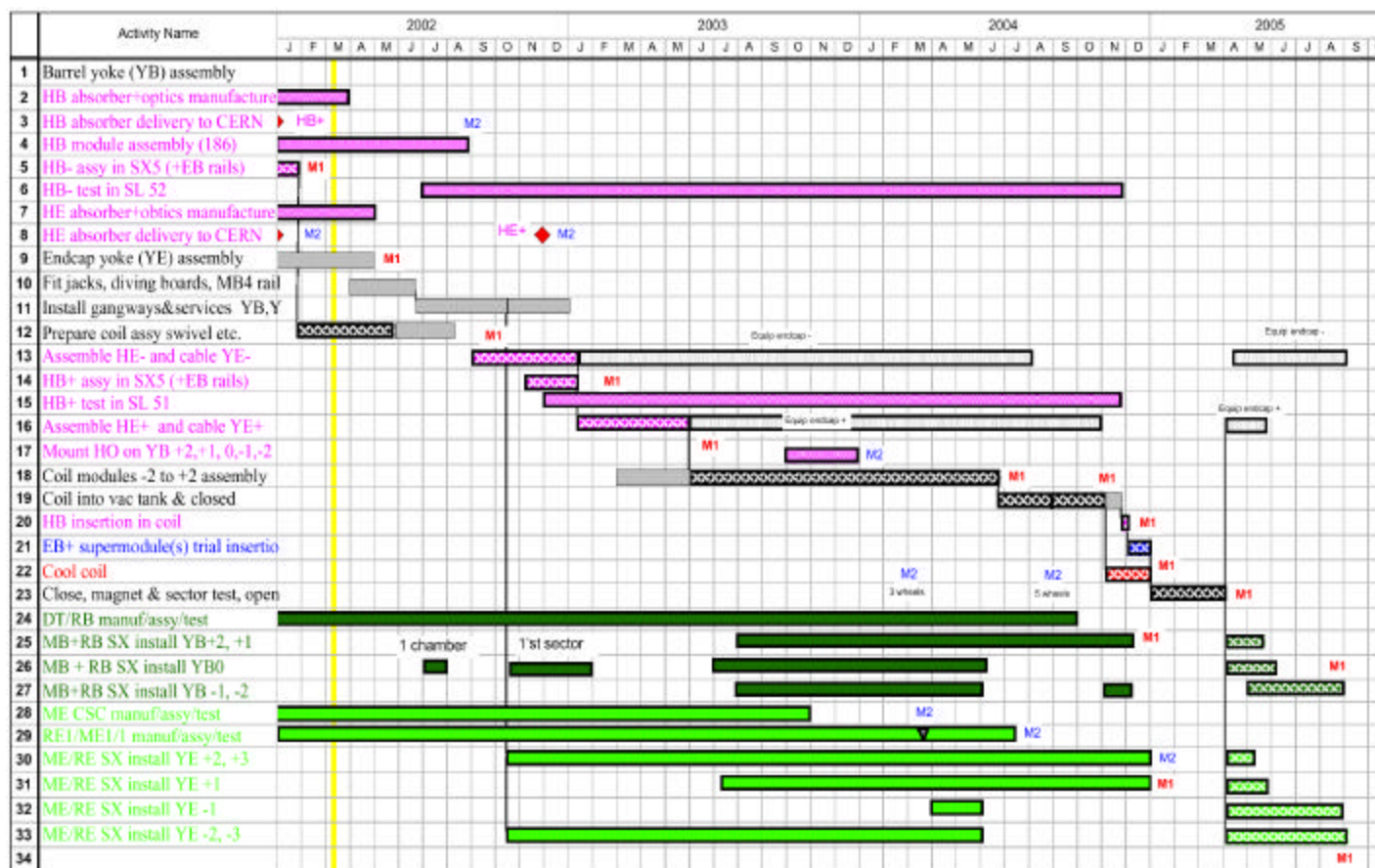
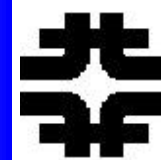
Progress: Si Tracker



Front-end hybrid with front-end ASICs



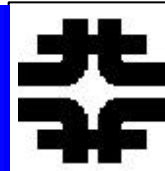
Schedule – 4/07 Beam



Delay in LHC machine and in UX5 Beneficial Occupancy means that mitigation and tests in SX5 must be planned.



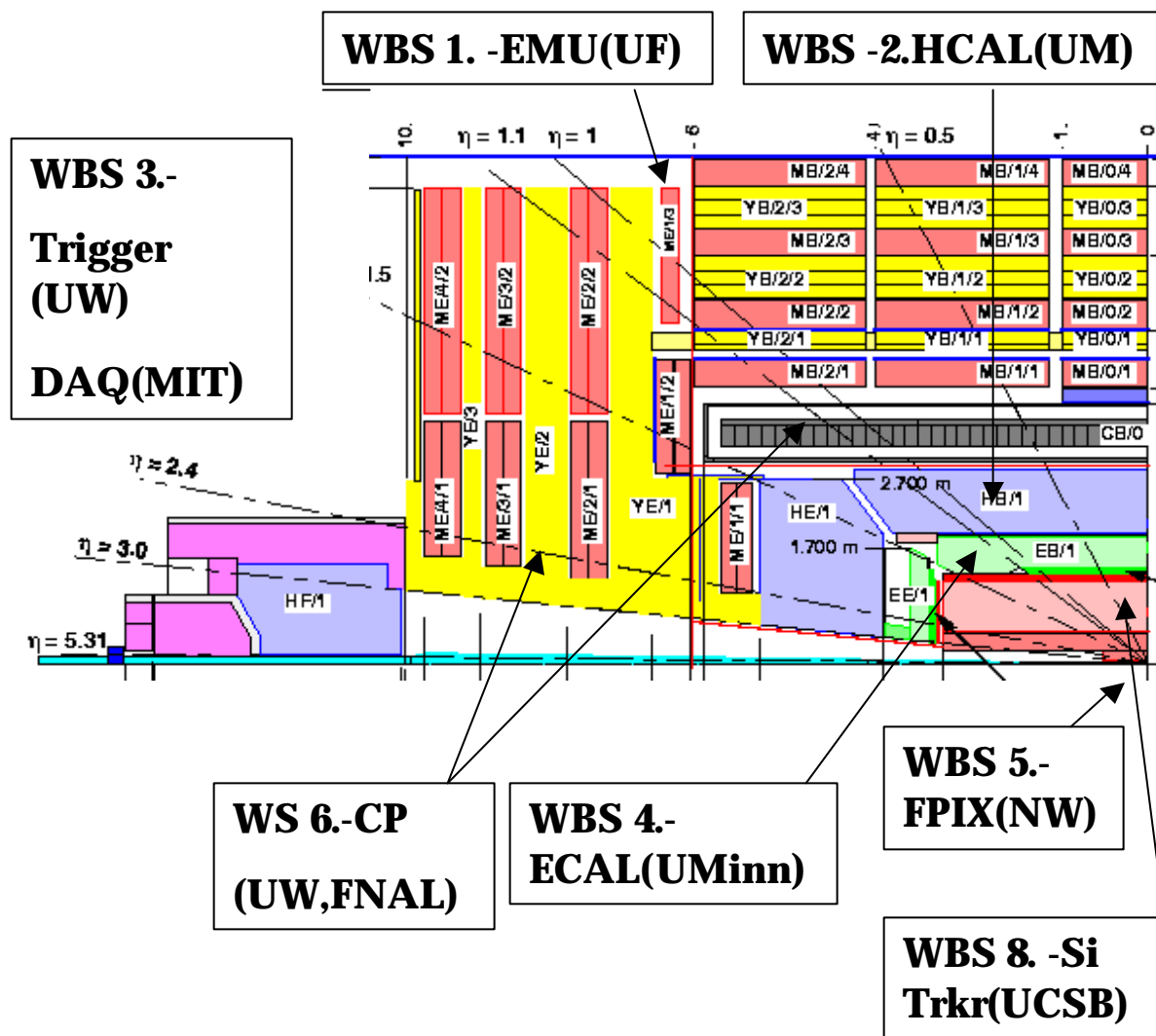
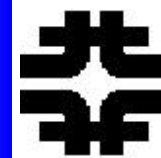
Point 5 - CMS



The UX5 area has turned the corner – no further delays due to civil construction problems are anticipated.



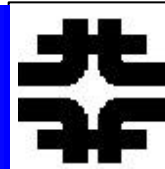
CMS and US CMS



1. Endcap Muon - Cathode Strip Chambers
2. Hadron Calorimeter - full HB, HOB, HE and HF transducers and readout.-HE scint, HF QP fibers
3. Endcap muon and calorimeter trigger. DAQ filter
4. Electromagnetic Calorimeter - barrel transducers, front end electronics, and laser monitor
5. Forward pixels
6. Common Projects - endcap yoke, barrel cryostat and superconductor
7. Project office
8. Si Tracker – full TOB



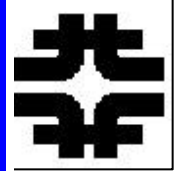
Installing ME Prototype



US CMS is scheduled to deliver chambers in 2002. They will need to be operated and tested. This situation leads to the plan for “slice tests”. They consist of data readout of the detector operated with a portable Trigger and DAQ in SX5.



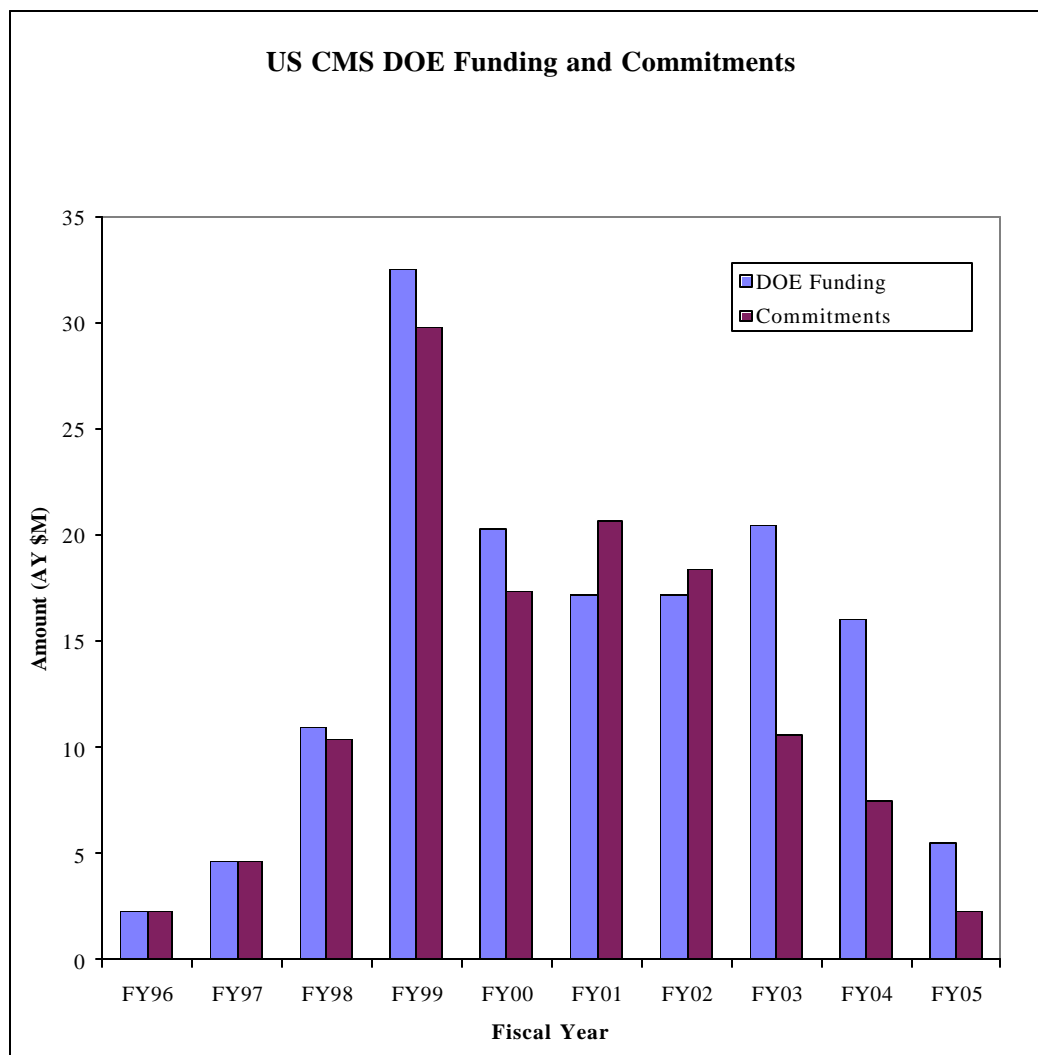
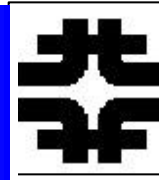
HB – Mechanics and Optics



HB- is installed in SX5, HB+ is complete and wedges are stuffed with megatiles in building 186. HE- is delivered to SX5. HF wedges are being delivered to CERN. Test beam is in 2002 with ~ final readout ASICs and optical links.



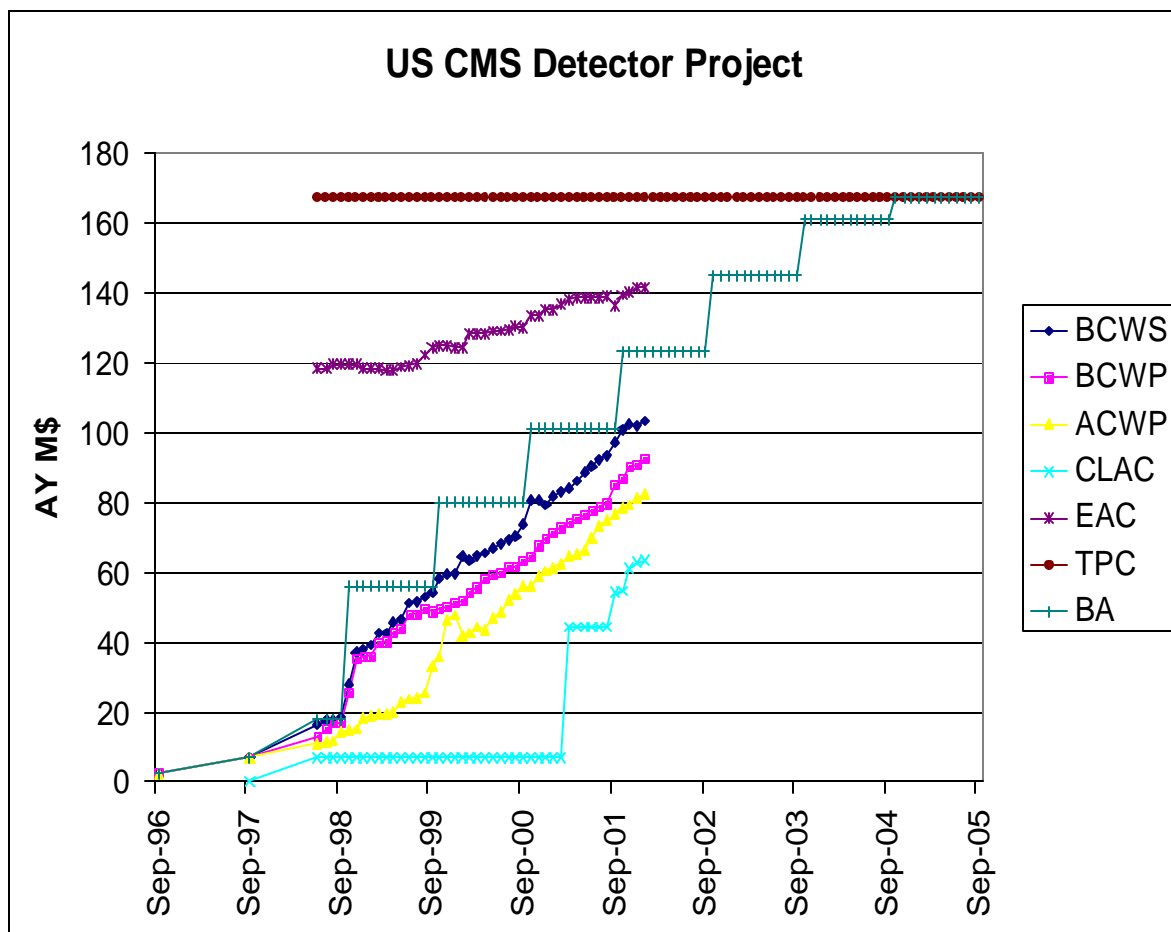
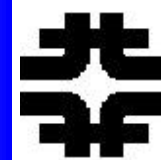
PO - Funding BA and Plan



The plan is to saturate the BA for the first 7 years and leave good sized contingency for the last 3 years. With the “current” CERN LHC schedule, US CMS will spill into FY06 by ~ 2 M\$ due to delayed installation in UX5. We are decoupled for delivery and commissioning in SX5.



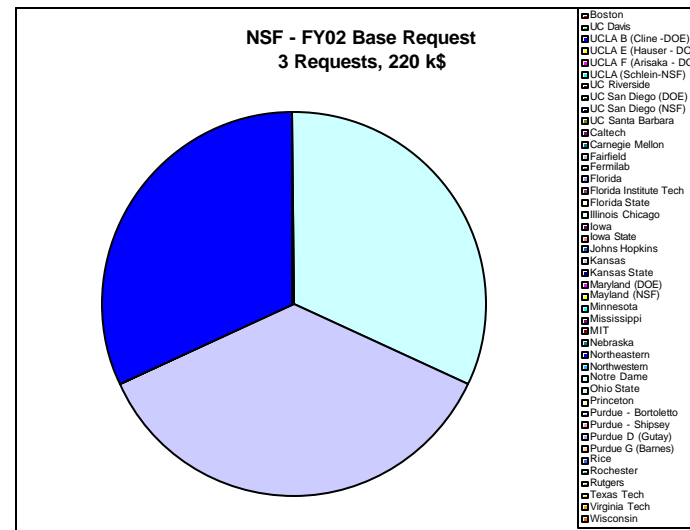
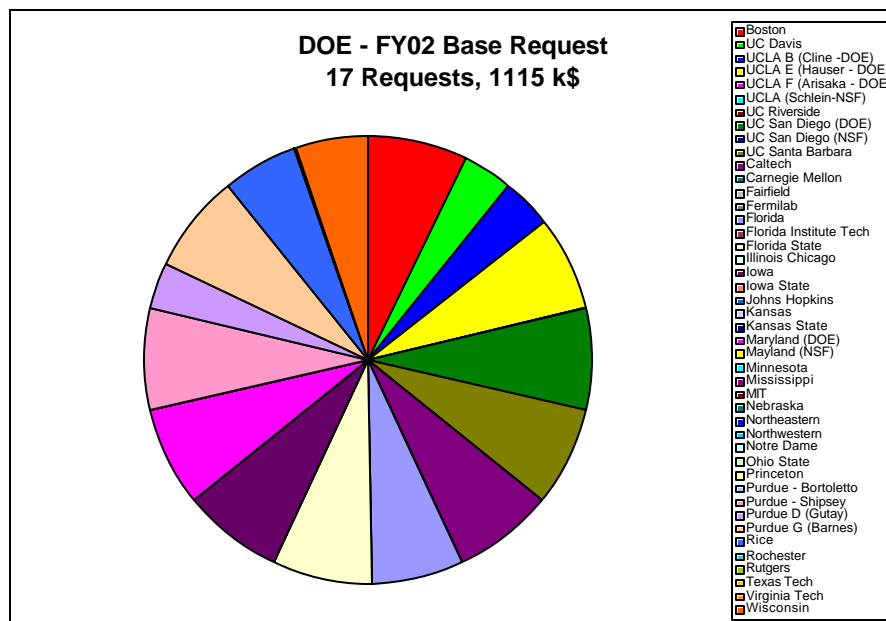
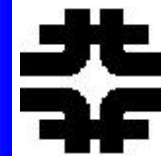
Trends, Closing Tasks



We are closing tasks after the finish date + 1 year. The lag in invoicing is ~ 6 months on average. The Project is 67% complete and retains 52% contingency on the work to completion



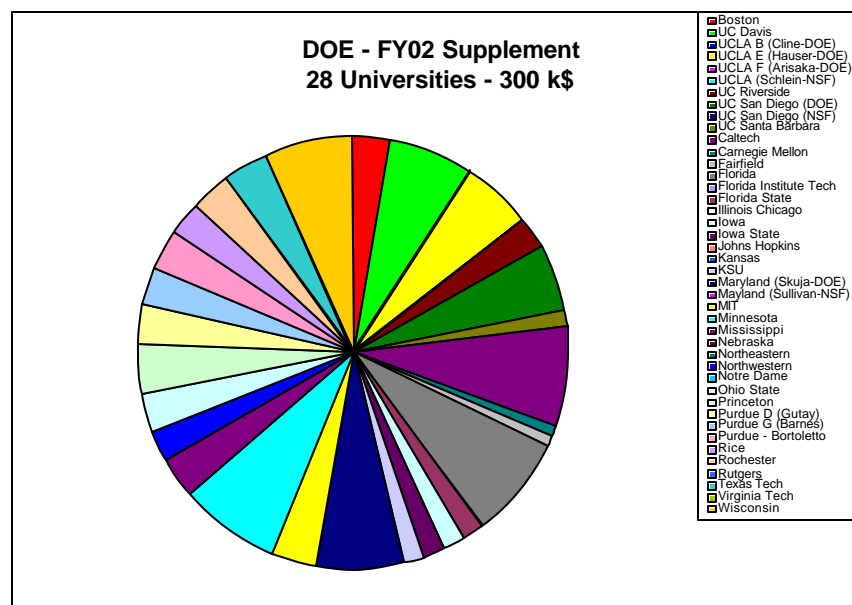
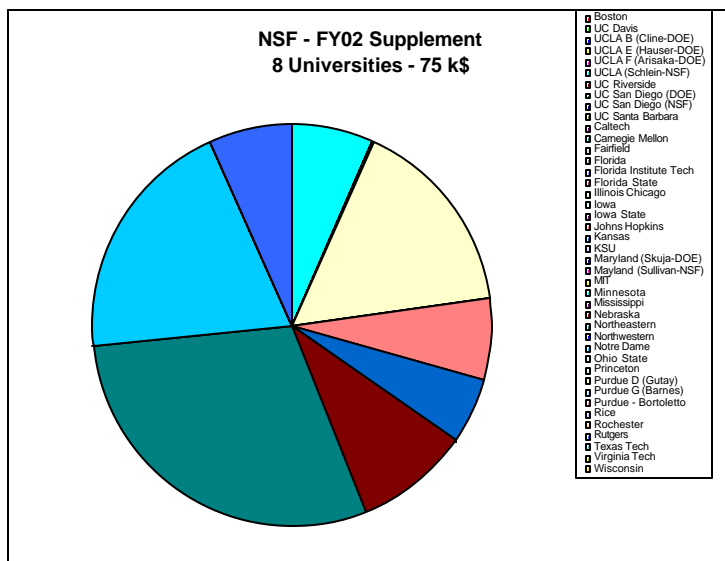
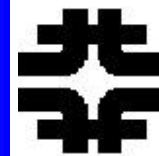
FY02 Base Request



At the start of each FY, US CMS makes a request for additional base support to DOE and NSF. For FY02 this request involved 20 university groups. The annual request serves as a point of contact between US CMS and the funding agencies when the priorities of US CMS can be brought to DOE and NSF.



FY02 Supplementary



In addition, funds are set aside by the DOE base program and the US CMS detector project (for NSF) in support of US CMS groups. For FY02, there were 36 university groups receiving support.



US CMS - Education



QuarkNet

QuarkNet will partner students and teachers with experiments at the world's most powerful accelerators, located at CERN in Switzerland and Fermilab in Illinois.



Students will:

- Investigate particle physics through live, online data
- Learn fundamental physics, from energy and momentum to the structure of matter
- Collaborate with students worldwide

Teachers will:

- Do research with teams of physicists at local universities and labs
- Construct and test detector components
- Create data sets
- Develop online student investigations
- Develop classroom detectors



QuarkNet is a collaboration of Fermilab and particle physics research groups in the ATLAS and CMS experiments located at 60 U.S. universities and laboratories.

Project Coordinator: Tom Jordan, Fermilab, tomjordan@fnal.gov, 630/840-4035
Project Directors: Marjorie Bardeen, Fermilab, mbardeen@fnal.gov; Keith Baker, Hampton University, baker@coehf.gmu.edu; Michael Barnett, Lawrence Berkeley National Laboratory, ATLAS, barnett@lbl.gov; Randy Blatch, University of Notre Dame, CMS, rbatch@und.edu; Andrew Eisenberg, Palo Alto High School, aerisenberg@paahs.org; Pat Mooney, Trinity School, mooney@trinity.org

Supported in part by Fermilab, Hampton University, Lawrence Berkeley National Laboratory, University of Notre Dame, the National Science Foundation, and the US Department of Energy

The US CMS PO supports proposals for educational initiatives. Randy Ruchti (N.D.), US CMS Education Coordinator, is responsible for prioritizing the proposals. Marge Bardeen is the FNAL leader – FNAL + NSF + Universities

The US CMS Project Office then funds the agreed upon proposals.

QuarkNet is a powerful example of the educational possibilities inherent in the LHC.



SWC: Tier – 1,2 in the US



DOE/NSF sponsor LHC Research Program includes Software and Computing

- ➔ Computing Infrastructure in the U.S. and software engineering for CMS
 - ◆ Mission is to develop and build “User Facilities” for CMS physics in the U.S.
 - To provide the enabling IT infrastructure that will allow U.S. physicists to fully participate in the physics program of CMS
 - ◆ To provide the U.S. share of the framework and infrastructure software

Tier-1 center at Fermilab provides computing resources and support

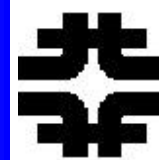
- ➔ User Support for “CMS physics community”, e.g. software distribution, help desk
- ➔ Support for Tier-2 centers, and for physics analysis center at Fermilab

Five Tier-2 centers in the U.S.

- ➔ Together will provide same CPU/Disk resources as Tier-1
- ➔ Facilitate “involvement of collaboration” in S&C development
 - ◆ Prototyping and test-bed effort very successful
- ➔ Universities will “bid” to host Tier-2 center
 - ◆ taking advantage of existing resources and expertise
- ➔ Tier-2 centers to be funded through NSF program for “empowering Universities”
 - ◆ Proposal to the NSF submitted Nov 2001



Preparing for First Beam



Prototyping, test-beds, R&D started in 2000
“Developing the LHC Computing Grid” in the U.S.

- ➡ R&D systems, funded in FY2002 and FY2003
 - ◆ Used for “5% data challenge” (end 2003)
 - ⇒ release Software and Computing TDR (technical design report)
- ➡ Prototype T1/T2 systems, funded in FY2004
 - ◆ for “20% data challenge” (end 2004)
 - ⇒ end “Phase 1”, Regional Center TDR, start deployment

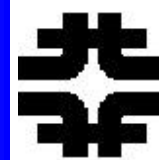
Deployment: 2005-2007, 30%, 30%, 40% costs

- ➡ Fully Functional Tier-1/2 funded in FY2005 through FY2007
 - ◆ ready for LHC physics run
 - ⇒ start of Physics Program

S&C Maintenance and Operations: 2007 on



Status and Progress



User Facilities status and successes:

- ➔ Tier-1 facility: R&D and User systems, Production CPU farms, Disk, Tape
- ➔ CMS software installation and distribution in place
- ➔ juggling R&D vs Support: "rave reviews" for UF from PRS user community
- ➔ Tier-2 prototype centers operational, R&D program, active in production efforts
- ➔ collaboration with U.S. ATLAS on facility issues, e.g. disks, procurements

Core Application Software status and successes:

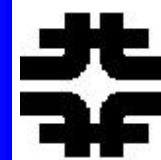
- ➔ released and use "Functional Prototype" Software for physics studies
- ➔ modularization and re-use of CMS code in creation of COBRA project
- ➔ visualization of all relevant reconstructed physics objects
- ➔ developed CMS distributed production environment w/ Grid middleware
- ➔ very significant Geant4 progress

Project Office started

- ➔ Project Engineer working on WBS, Schedule, Budget, Reporting, Documenting
- ➔ SOWs in place w/ CAS Universities — soon MOUs, subcontracts, invoicing



User Facilities Status



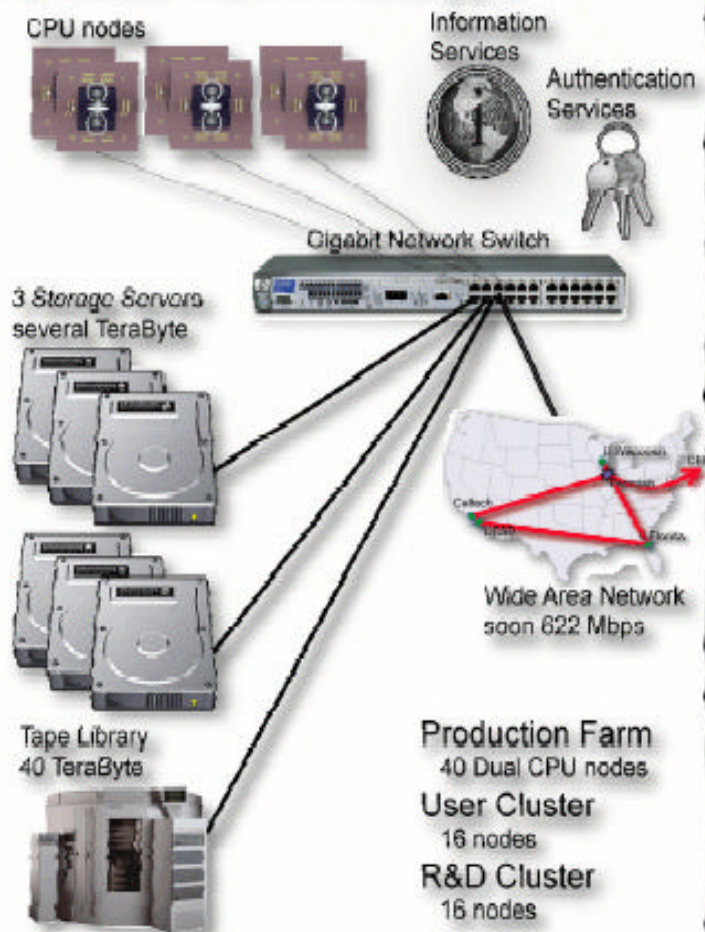
U.S. User Facilities established

- ➔ Facilities for event simulation, including reconstruction and sophisticated pile-up processing
- ➔ User cluster and hosting of large data samples for physics studies
- ➔ Facilities and Grid R&D

Excellent initial effort and DOE/NSF support for User Facilities

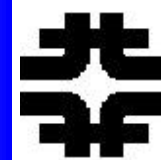
- ➔ Fermilab established as Tier-1 prototype and major Grid node for LHC computing
- ➔ Two Tier-2 prototypes established, strong interaction with Grid projects
- ➔ R&D to develop distributed environment for LHC physics research started
- ➔ Head-start for U.S. efforts pushed CERN commitment to support remote sites

Fermilab Tier-1 Prototype



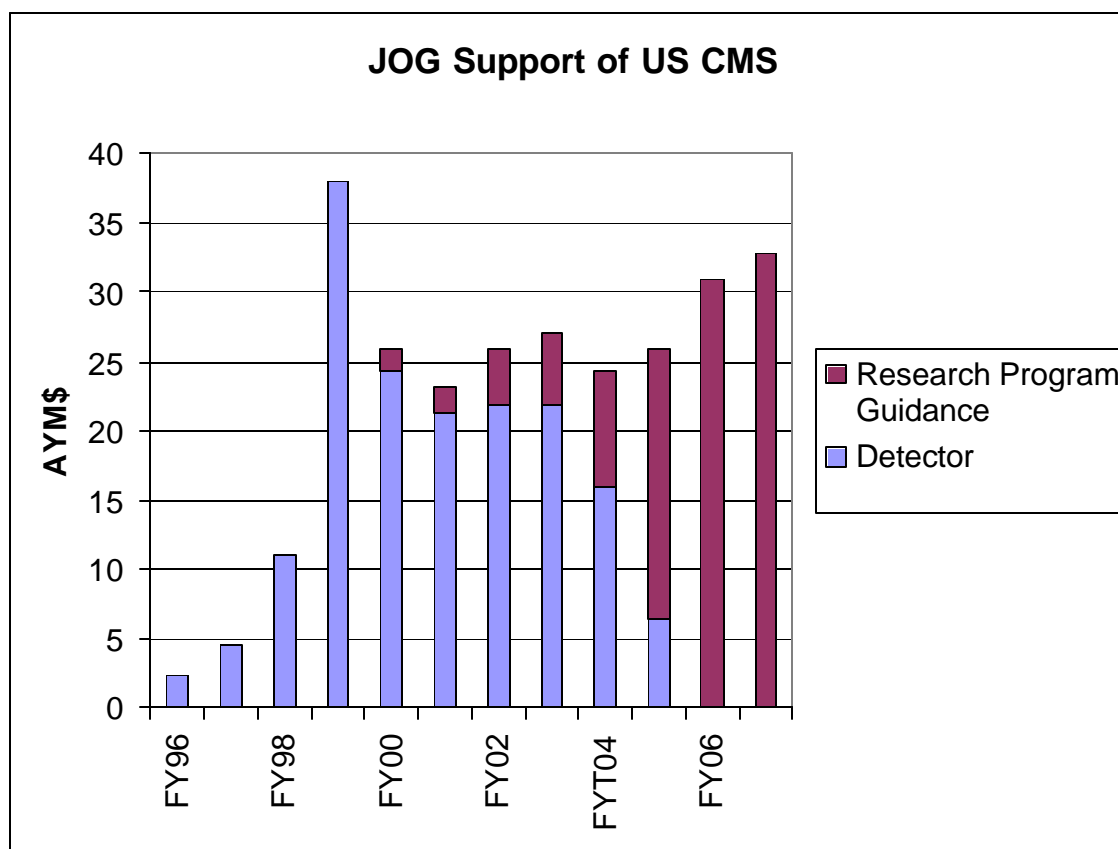
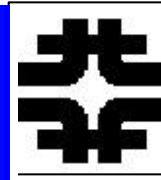


Prototype Operation

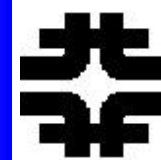




Guidance for the Research Program



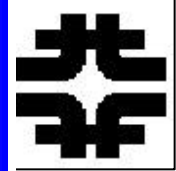
US CMS have received guidance from DOE and NSF. The Research Program contains SWC, M&O and R&D for upgrades. Review was on April 9-11. There will be intense future scrutiny.



HEPAP at FNAL, April 26-27, 2002



Summary



- **Fermilab is involved in US CMS both as the “host laboratory” and as one of the collaborating institutions.**
- **As the host, FNAL contributes access to existing facilities in order to support university groups. New initiatives are charged to the US CMS Project.**
- **The US CMS PO at FNAL provides management for the construction project.**
- **The US CMS Construction Project is on schedule and on budget.**
- **The SWC effort is well launched with the aim of being fully functional by the first beam.**
- **Planning for the US CMS Research Program began 2 years ago. It will continue to be refined.**